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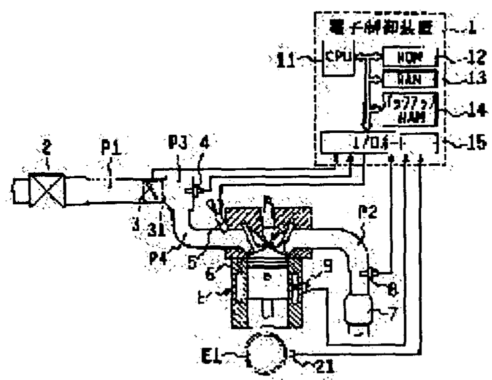
(54) FUEL INJECTION CONTROL METHOD

(57)Abstract:

PURPOSE: To enable injection and supply of an optimum rate of fuel by performing linear approximation of fluctuation of an intake pipe pressure, and estimating an intake pipe pressure at the termination time of an intake process.

CONSTITUTION: In respect to an ECU 1, pressure in an intake pipe is read by a pressure sensor 4, and an engine speed at that time is obtained by an engine speed sensor 21. Fluctuation of the intake pipe pressure is under linear approximation with inclination which is difference between the intake pipe pressure detected previous time and the intake pipe pressure detected this time. The intake pipe pressure at the termination of intake process is estimated from the fluctuation of the intake pipe pressure under linear approximation. A fuel injection rate at the injection time is calculated based on the estimated intake pipe pressure. An actual intake amount in a transient condition during acceleration of a car is calculated by easy computation. The intake pipe pressure is estimated when an intake valve 6 is closed. An optimum fuel injection rate is obtained based on this. Intake rate error is eliminated, which error is caused by signal delay at a noise removing filter arranged in a pressure sensor system.



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CLAIMS

[Claim(s)]
[Claim 1] While carrying out straight-line approximation of the change of the pressure-of-induction-pipe force by making into an inclination the difference of the pressure-of-induction-pipe force which detected the pressure-of-induction-pipe force at the time of the fuel injection to a predetermined engine cylinder, and was detected last time, and the pressure-of-induction-pipe force detected this time The fuel-injection control method characterized by presuming the pressure-of-induction-pipe force at the time of the intake-stroke end of the above-mentioned engine cylinder, and computing the injection fuel quantity at the time of the above-mentioned fuel injection based on the presumed pressure-of-induction-pipe force from change of the pressure-of-induction-pipe force by which straight-line approximation was carried out.
[Claim 2] The fuel-injection control method according to claim 1 which carries out primary lead compensation of the pressure-of-induction-pipe force by which presumption was carried out [above-mentioned] with the value proportional to the variation of the pressure-of-induction-pipe force, and computes the injection fuel quantity at the time of the above-mentioned fuel injection based on the compensated pressure-of-induction-pipe force.
[Claim 3] The fuel-injection control method according to claim 1 which compensates with the value proportional to each variation primarily both the pressure-of-induction-pipe force detected last time [above-mentioned] and the pressure-of-induction-pipe force detected this time, and carries out straight-line approximation of the change of the pressure-of-induction-pipe force from the difference of the pressure-of-induction-pipe force of the last time after compensation, and this pressure-of-induction-pipe force.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] Especially this invention relates to the method of performing optimal fuel-injection control, in the fuel injection of a D-J (JETRO nick) method about the fuel-injection control method.
[0002]
[Description of the Prior Art] D-J fuel injection computes the amount of inhalation of air to engine each cylinder from the pressure-of-induction-pipe force of a throttle-valve lower stream of a river, and carries out injection supply of the optimal fuel according to the amount of inhalation of air. In this case, the pressure-of-induction-pipe force detected by the pressure sensor prepared in the surge tank of an inlet pipe produces a big difference in the time of acceleration of vehicles etc. in the time of fuel injection, and the time of a predetermined engine cylinder finishing a charging stroke especially (distance delay). Therefore, in having injected fuel according to the amount of inhalation of air computed from the pressure-of-induction-pipe force at the time of fuel injection, since there are more amounts of inhalation of air actually inhaled by the engine cylinder, it becomes fuel RIN. Then, based on the dynamic physics model about an inhalation air content, to JP,1-271642,A, the pressure-of-induction-pipe force at the time of inhalation is presumed from the pressure-of-induction-pipe force at the time of detection, and what performs fuel injection based on the amount of inhalation of air computed from this is proposed.
[0003]
[Problem(s) to be Solved by the Invention] However, in fuel-injection control given [above-mentioned] in an official report, since it is necessary to perform a quite complicated operation, there is a problem that a burden is large, with the microcomputer of vehicles loading.
[0004] Moreover, although the filter from which a noise and a ripple are removed is usually prepared in the detector of the pressure-of-induction-pipe force, the difference between the amount of inhalation of air which the delay of the signal in this filter computed from the pressure-of-induction-pipe force further, and the actual amount of inhalation of air is increased (sensor delay).
[0005] Then, the purpose of 1 of this invention presumes the pressure-of-induction-pipe force at the time of a cylinder charging-stroke end by the easy operation, compensates distance delay, and offers the fuel-injection control method which carries out injection supply of the optimal fuel quantity according to the amount of inhalation of air obtained based on the presumed pressure-of-induction-pipe force. Moreover, other purposes of this invention offer the fuel-injection control method which carries out injection supply of the fuel of optimum dose further by compensating the signal delay (sensor delay) in a filter.
[0006]
[Means for Solving the Problem] While carrying out straight-line approximation of the change of the pressure-of-induction-pipe force by making into an inclination the difference of the pressure-of-induction-pipe force which detected the pressure-of-induction-pipe force at the time of the fuel injection to a predetermined engine cylinder, and was detected last time with composition according to claim 1, and the pressure-of-induction-pipe force detected this time From change of the pressure-of-induction-pipe force by which straight-line approximation was carried out, the pressure-of-induction-pipe force at the time of the intake-stroke end of the above-mentioned engine cylinder is presumed, and the injection fuel quantity at the time of the above-mentioned fuel injection is computed based on the presumed pressure-of-induction-pipe force. Moreover, with composition according to claim 2, primary lead compensation of the pressure-of-induction-pipe force by which presumption was carried out [above-mentioned] is carried out with the value proportional to the variation of the pressure-of-induction-pipe force, and the injection fuel quantity at the time of the above-mentioned fuel injection is computed based on the compensated pressure-of-induction-pipe force. Furthermore, with composition according to claim 3, both the pressure-of-induction-pipe force

detected last time [above-mentioned] and the pressure-of-induction-pipe force detected this time are primarily compensated with the value proportional to each variation, and straight-line approximation of the change of the pressure-of-induction-pipe force is carried out from the difference of the pressure-of-induction-pipe force of the last time after compensation, and this pressure-of-induction-pipe force.
[0007]
[Function] In composition according to claim 1, since straight-line approximation of the change of the pressure-of-induction-pipe force was carried out and the pressure-of-induction-pipe force at the time of the intake-stroke end of an engine cylinder is presumed, an operation is simple, and if injection fuel quantity is computed based on this presumed pressure-of-induction-pipe force, it will become the optimal amount according to the actual amount of inhalation of air. In the composition of claims 2 and 3, since primary lead compensation of the pressure-of-induction-pipe force is carried out with the value proportional to the variation, the signal delay (sensor delay) in the filter prepared in a pressure detection system is compensated, and still more suitable injection fuel quantity is obtained.
[0008]
[Example 1] The hard composition which realizes this invention method is shown in drawing 1 . An air cleaner 2 is formed in the best style position at the inlet pipe P1 of Engine E, and the throttle valve 3 is arranged into the inlet pipe which results in a surge tank P3 from this air cleaner 2. The pressure sensor 4 which detects the pressure-of-induction-pipe force is formed in a surge tank P3, and the fuel injection valve 5 is formed in the inlet manifold P4 which branches in each cylinder of Engine E from a surge tank P3, respectively. A gaseous mixture is supplied into an engine cylinder through an inlet valve 6.
[0009] The air-fuel ratio sensor 8 is formed in the upper position of a three way component catalyst 7 at the exhaust pipe P2 of an engine, and the coolant temperature sensor 9 is formed in the water jacket of an engine E main part.
[0010] An electronic control (ECU) 1 is formed and this consists of CPU11, ROM12, RAM13, the backup RAM 14, and the I/O (I/O) ports 15 which were mutually connected by the data bus. The opening of the above-mentioned throttle valve 3 was detected by the opening sensor 31 attached to this, and is inputted into the I/0 above-mentioned port 15. Moreover, each output signal of the above-mentioned pressure sensor 4, the air-fuel ratio sensor 8, and a coolant temperature sensor 9 is also inputted into above-mentioned I/O Port 15. This is countered, the rotational frequency sensor 21 is formed in the starter ring E1 which rotates synchronizing with the crankshaft of Engine E, and 24 pulse signals are outputted to every 2 of an engine rotations (720 degrees) to above-mentioned I/O Port 15. CPU11 computes an engine speed Ne and a crank angle based on this pulse signal. CPU11 determines the optimal fuel oil consumption based on each above-mentioned signal according to the below-mentioned control program by which the store was carried out to ROM12, and carries out the open operation of the fuel injection valve 5 through I/O Port 15.
[0011] The procedure of the fuel-injection control in CPU1 is shown in drawing 2 . Drawing is what explained in detail the presumed procedure of the amount of inhalation of air which will be the requisite for fuel quantity determination, and this amount presumption routine of inhalation of air is started by the timer interruption for every toms.
[0012] At Step 101, while reading the pressure-of-induction-pipe force Pm from a pressure sensor 4, the engine speed Ne at this time is obtained. At Step 102, difference deltaPm of the pressure-of-induction-pipe force is computed by lower formula **, and let this be the inclination of the pressure-of-induction-pipe force Pm which carried out straight-line approximation.
deltaPm=Pm-Pmo .... It is the pressure-of-induction-pipe [which is **] force with which Pmo was detected last time.
[0013] At continuing Step 103, a pressure Pm is memorized as a pressure Pmo. It is the time (distance time delay) t1 to inlet-valve 6 valve closing from the crank angle with which it checked whether the time of fuel-oil-consumption calculation had come at Step 104, it progressed to Step 105 when it was at the calculation time, and it was beforehand known to inlet-valve 6 valve closing (intake-stroke end), and the present engine speed. It computes. At Step 106, it is the above-mentioned distance time delay t1. It changes into the number of times n of thump RINNGU by lower formula **.
n=t1 / to .... ** [0014] At Step 107, straight-line approximation of the change of the pressure-of-induction-pipe force is carried out, and pressure-of-induction-pipe force Pmso' in front of toms is computed [number of times / n / the pressure-of-induction-pipe force Pm at the time of fuel-oil-consumption calculation, pressure-differential deltaPm, and / of a sampling] for pressure-of-induction-pipe force Pms' at the time of inlet-valve 6 valve closing from the time of inlet-valve 6 valve closing by lower formula ** at lower formula **, respectively.
Pms'= Pm+n-delta Pm .... **Pmso'=Pm+ (n-1) and deltaPm .. ** [0015] At Step 108, calculation presumption of the final pressure-of-induction-pipe force Pmt at the time of inlet-valve 6 valve closing is carried out from lower formula **.
Pmt=k(Pms'-Pmso') +Pmso' .... ** -- here, the 1st term of ** formula is a primary lead compensation term, and k is a constant determined in consideration of the amount of signal delay in the noise absorption filter prepared in a pressure-

sensor system
[0016] At Step 109, the amount of inhalation of air is computed by the method better known than the presumed pressure-of-induction-pipe force Pmt, and a calculation decision of the fuel oil consumption which realizes a desired air-fuel ratio is made, taking engine-coolant water temperature etc. into consideration based on this.
[0017] In this way, without making the burden of a computer increase according to this example, the pressure-of-induction-pipe force at the time of inlet-valve 6 valve closing can be presumed according to a simple operation, and the optimal fuel oil consumption can be obtained based on this. Moreover, since primary lead compensation of the final presumed pressure-of-induction-pipe force is carried out, it can make small influence of signal delay with the noise absorption filter prepared in a pressure-sensor system, and can obtain the thing near the actual pressure-of-induction-pipe force at the time of inlet-valve 6 valve closing.
[0018]
[Example 2] Although difference deltaPm of the pressure-of-induction-pipe force Pm was computed for every timer interruption in the above-mentioned example (Step 102 of drawing 2), a calculation interval may not become size with sufficient short ** past ******** deltaPm. Then, this example shown in drawing 3 aims at the solution.
[0019] In drawing, after incorporating the pressure-of-induction-pipe force Pm and an engine speed Ne at Step 201 started every 4ms, it checks in the time of fuel-oil-consumption calculation (Step 202), and if it is not at the calculation time, it will progress to Step 214, Counter count will be counted up, and processing will be ended.
[0020] If it is at the fuel-oil-consumption calculation time, the detected pressure-of-induction-pipe force Pm is memorized as Pmf (Step 203), and from lower formula **, pressure-differential deltaPmf will be computed and let this be the variation of the pressure-of-induction-pipe force Pmf.
deltaPmf=Pmf-Pmfo .... ** -- here, Pmfo is the last pressure-of-induction-pipe force
[0021] Lower formula ** memorizes a pressure Pmf as a pressure Pmfo and performs primary lead compensation continuously at continuing Step 205.
Pmt=k-delta Pmf+Pmfo .... ** -- here, k is the same constant as the above-mentioned example 1 explained (refer to ** formula)
[0022] At Step 207, pressure-differential deltaPmt is computed from lower formula **, and let this be the inclination of change of the pressure-of-induction-pipe force Pmt which carried out straight-line approximation.
deltaPmt=Pmt-Pmto .... ** [0023] It is the time t1 from the time of fuel-oil-consumption calculation (present) to inlet-valve 6 valve closing from the crank angle from which the pressure Pmt was memorized as Pmto, and it was continuously known for Step 208 to inlet-valve 6 valve closing (intake-stroke end) beforehand, and the present engine speed Ne. It computes (Step 209). At Step 210, the elapsed time to from the time of last fuel-oil-consumption calculation is computed by hanging 4 (ms) on the value of the counter count so far, and Counter count is reset (Step 211). And calculation presumption of the pressure-of-induction-pipe force Pms at the time of inlet-valve 6 valve closing is carried out by lower formula ** at Step 212.
Pms=Pmt+(t1 / to) -deltaPmt .... ** [0024] At Step 213, the amount of inhalation of air is computed based on the presumed pressure-of-induction-pipe force, and a calculation decision of the fuel oil consumption which realizes a desired air-fuel ratio is made.
[0025] since the difference of the pressure-of-induction-pipe force is performed for every time of the remote fuel-oil-consumption calculation which is an interval while there is the same effect as the above-mentioned example also by this example, sufficient difference can be acquired when pressure variation is relatively small
[0026] In addition, although primary lead compensation of the detection value of the pressure-of-induction-pipe force is carried out first and the fuel oil consumption at the time of inlet-valve 6 valve closing was determined from the pressure-of-induction-pipe force after these compensation after that in this example, you may make the above-mentioned example 1 be the same as that of this.
[0027]
[Effect of the Invention] While being able to presume correctly the actual amount of inhalation of air in the transients at the time of vehicles acceleration etc. by the easy operation like the above according to the fuel-injection control method of this invention, it is possible to also remove the amount presumption error of inhalation of air resulting from signal delay with the noise rejection filter prepared in a pressure-sensor system.

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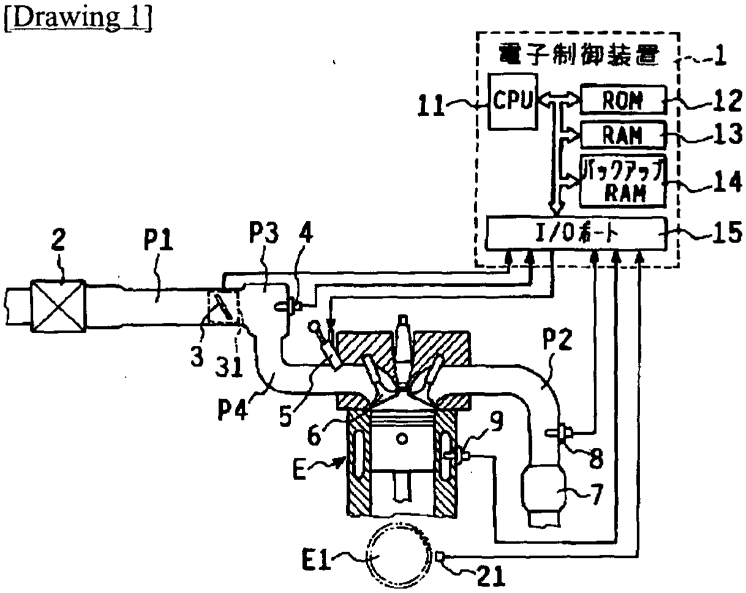
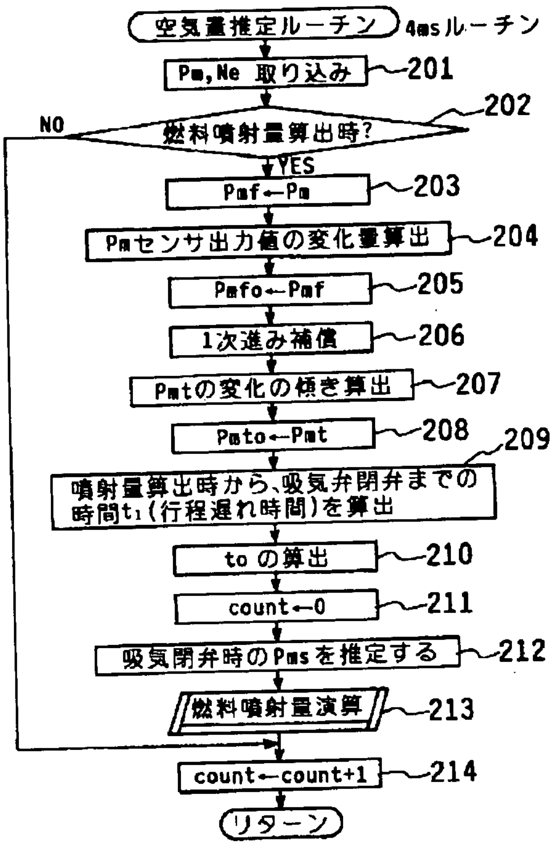
* NOTICES *

DRAWINGS

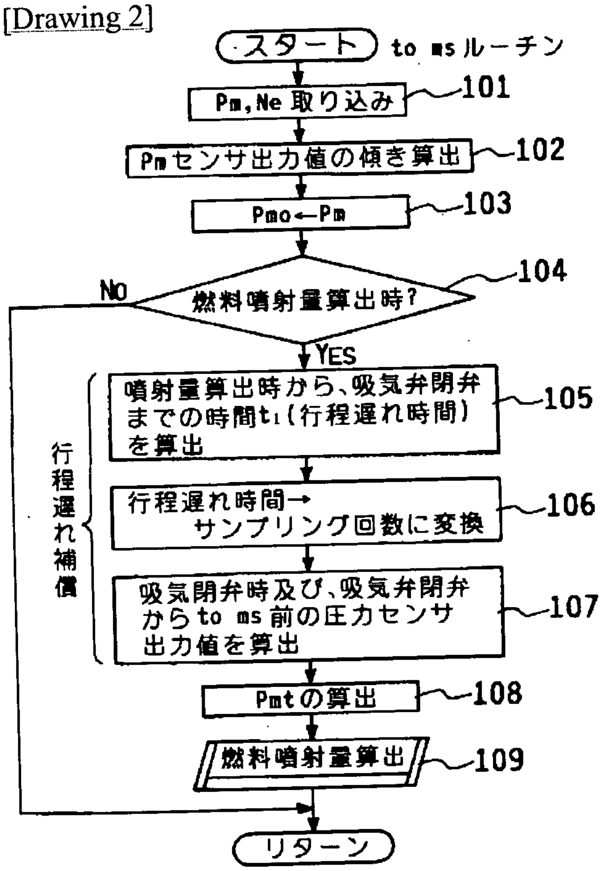
[Drawing 1]



[Drawing 3]



[Drawing 2]



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審査請求　未請求　請求項の数３　ＦＤ　（全　５　頁）　最終頁に続く

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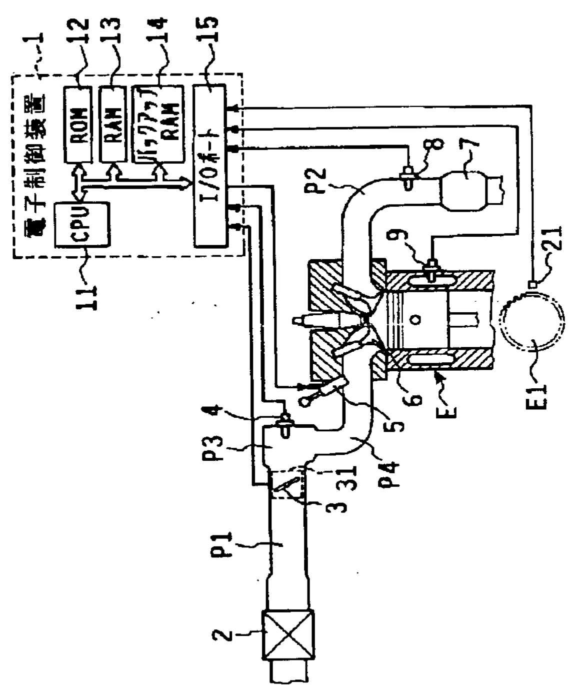
(54)【発明の名称】　燃料噴射制御方法

(57)【要約】

【目的】　簡単な演算で気筒吸入行程終了時の吸気管圧力を推定し、推定された吸気管圧力に基いて得られた吸気量に応じて最適な燃料量を噴射供給する。

【構成】　圧力センサ４により所定のエンジンＥ気筒への燃料噴射時の吸気管圧力を検出し、電子制御装置１は、先回検出した吸気管圧力と今回検出した吸気管圧力の差より吸気管圧力の変化を直線近似するとともに、直線近似された吸気管圧力の変化より、上記エンジン気筒の吸気行程終了時の吸気管圧力を推定し、推定された吸気管圧力に基づいて燃料噴射時の噴射燃料量を算出する。



【特許請求の範囲】

【請求項1】　所定のエンジン気筒への燃料噴射時の吸気管圧力を検出し、先回検出した吸気管圧力と今回検出した吸気管圧力の差を傾きとして吸気管圧力の変化を直線近似するとともに、直線近似された吸気管圧力の変化より、上記エンジン気筒の吸気行程終了時の吸気管圧力を推定し、推定された吸気管圧力に基づいて上記燃料噴射時の噴射燃料量を算出することを特徴とする燃料噴射制御方法。

【請求項2】　上記推定された吸気管圧力を、吸気管圧力の変化量に比例した値で一次進み補償して、補償された吸気管圧力に基づいて上記燃料噴射時の噴射燃料量を算出する請求項1記載の燃料噴射制御方法。

【請求項3】　上記先回検出した吸気管圧力と今回検出した吸気管圧力をともにそれぞれの変化量に比例した値で一次補償し、補償後の先回の吸気管圧力と今回の吸気管圧力の差より吸気管圧力の変化を直線近似する請求項1記載の燃料噴射制御方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は燃料噴射制御方法に関し、特にD－J（ジェトロニック）方式の燃料噴射において、最適な燃料噴射制御を行う方法に関する。

【0002】

【従来の技術】D－J燃料噴射は、スロットル弁下流の吸気管圧力よりエンジン各気筒への吸気量を算出して、吸気量に応じた最適な燃料を噴射供給するものである。この場合、吸気管のサージタンクに設けた圧力センサで検出される吸気管圧力は、特に車両の加速時等においては、燃料噴射時と、所定のエンジン気筒が吸入行程を終えた時とでは大きな差を生じる（行程遅れ）。したがって、燃料噴射時の吸気管圧力より算出された吸気量に応じて燃料を噴射したのでは、実際にエンジン気筒に吸入される吸気量の方が多いため燃料リーンとなる。そこで、特開平1－271642号公報には、吸入空気量に関する動的物理モデルに基づいて検出時の吸気管圧力より吸入時の吸気管圧力を推定し、これより算出した吸気量に基づいて燃料噴射を行うものが提案されている。

【0003】

【発明が解決しようとする課題】しかし、上記公報記載の燃料噴射制御では、かなり複雑な演算を行う必要があるため、車両搭載のマイクロコンピュータでは負担が大きいという問題がある。

【0004】また、通常、吸気管圧力の検出回路にはノイズやリップルを除去するフィルタが設けられているが、このフィルタでの信号の遅れがさらに吸気管圧力より算出した吸気量と実際の吸気量との差異を増大させている（センサ遅れ）。

【0005】そこで、本発明の一の目的は、簡単な演算で気筒吸入行程終了時の吸気管圧力を推定して行程遅れを補償し、推定された吸気管圧力に基いて得られた吸気量に応じて最適な燃料量を噴射供給する燃料噴射制御方法を提供するものである。また、本発明の他の目的は、フィルタでの信号遅れ（センサ遅れ）を補償することにより、さらに適量の燃料を噴射供給する燃料噴射制御方法を提供するものである。

【0006】

【課題を解決するための手段】請求項1記載の構成では、所定のエンジン気筒への燃料噴射時の吸気管圧力を検出し、先回検出した吸気管圧力と今回検出した吸気管圧力の差を傾きとして吸気管圧力の変化を直線近似するとともに、直線近似された吸気管圧力の変化より、上記エンジン気筒の吸気行程終了時の吸気管圧力を推定し、推定された吸気管圧力に基づいて上記燃料噴射時の噴射燃料量を算出している。また、請求項2記載の構成では、上記推定された吸気管圧力を、吸気管圧力の変化量に比例した値で一次進み補償して、補償された吸気管圧力に基づいて上記燃料噴射時の噴射燃料量を算出する。さらに、請求項3記載の構成では、上記先回検出した吸気管圧力と今回検出した吸気管圧力をともにそれぞれの変化量に比例した値で一次補償し、補償後の先回の吸気管圧力と今回の吸気管圧力の差より吸気管圧力の変化を直線近似する。

【0007】

【作用】請求項1記載の構成において、吸気管圧力の変化を直線近似してエンジン気筒の吸気行程終了時の吸気管圧力を推定しているから演算が簡易であり、この推定された吸気管圧力に基づいて噴射燃料量を算出すれば実際の吸気量に応じた最適な量となる。請求項2，3の構成においては、吸気管圧力をその変化量に比例した値で一次進み補償しているから、圧力検出系に設けられるフィルタでの信号遅れ（センサ遅れ）が補償され、さらに好適な噴射燃料量が得られる。

【0008】

【実施例1】図1には、本発明方法を実現するハード構成を示す。エンジンEの吸気管P1には最上流位置にエアクリーナ2が設けられ、このエアクリーナ2よりサージタンクP3に至る吸気管中にスロットルバルブ3が配設されている。サージタンクP3には吸気管圧力を検出する圧力センサ4が設けられ、サージタンクP3よりエンジンEの各気筒に分岐する吸気マニホールドP4にはそれぞれ燃料噴射弁5が設けられている。混合気は吸気弁6を経てエンジン気筒内へ供給される。

【0009】エンジンの排気管P2には三元触媒7の上流位置に空燃比センサ8が設けられ、また、エンジンE本体のウォータジャケットには水温センサ9が設けられている。

【0010】電子制御装置（ECU）1が設けられ、これは互いにデータバスにより接続されたCPU11、ROM12、RAM13、バックアップRAM14、およ

び入出力（I／O）ポート15より構成されている。上記スロットル弁3の開度はこれに付設された開度センサ31により検出されて上記I／0ポート15に入力している。また、上記圧力センサ4、空燃比センサ8、および水温センサ9の各出力信号も上記I／Oポート15に入力している。エンジンEのクランク軸と同期して回転するリングギヤE1には、これに対向して回転数センサ21が設けられ、エンジンの2回転（720度）毎に24個のパルス信号を上記I／Oポート15へ出力する。CPU11はこのパルス信号に基づいてエンジン回転数Neやクランク角を算出する。CPU11はROM12にストアされた後述の制御プログラムに従って上記各信号に基づき最適な燃料噴射量を決定し、I／Oポート15を介して燃料噴射弁5を開放作動せしめる。

【0011】図2にはCPU1における燃料噴射制御の手順を示す。図は燃料量決定の前提となる吸気量の推定手順を詳細に説明したもので、この吸気量推定ルーチンはtoms毎のタイマ割込みで起動する。

【0012】ステップ101では圧力センサ4より吸気管圧力Pmを読み込むとともに、この時のエンジン回転数Neを得る。ステップ102では下式①により吸気管圧力の差ΔPmを算出し、これを、直線近似した吸気管＊

＊圧力Pmの傾きとする。

$$\Delta Pm = Pm - Pmo \cdots\cdots ①$$

なお、Pmoは先回検出された吸気管圧力である。

【0013】続くステップ103では圧力Pmを圧力Pmoとして記憶する。ステップ104で燃料噴射量算出時が到来したか確認し、算出時であればステップ105へ進んで、吸気弁6閉弁（吸気行程終了）までの予め知られたクランク角と現在のエンジン回転数より、吸気弁6閉弁までの時間（行程遅れ時間）t1 を算出する。ステップ106では、上記行程遅れ時間t1 を下式②によりサンプリンング回数nに変換する。

$$n = t1 / to \cdots\cdots ②$$

【0014】ステップ107では、吸気管圧力の変化を直線近似して、燃料噴射量算出時の吸気管圧力Pm、圧力差ΔPmおよびサンプリング回数nより、下式③で吸気弁6閉弁時の吸気管圧力Pms´を、下式④で吸気弁6閉弁時よりtoms前の吸気管圧力Pmso´をそれぞれ算出する。

$$Pms' = Pm + n \cdot \Delta Pm \cdots\cdots ③$$

$$Pmso' = Pm + (n-1) \cdot \Delta Pm \cdots\cdots ④$$

【0015】ステップ108では、下式⑤より吸気弁6閉弁時の最終的な吸気管圧力Pmtを算出推定する。

$$Pmt = k\,(Pms' - Pmso') + Pmso' \cdots\cdots ⑤$$

ここで、⑤式の第1項は一次進み補償項であり、kは圧力センサ系に設けられるノイズ吸収フィルタにおける信号遅れ量を考慮して決定される定数である。

【0016】ステップ109では、推定された吸気管圧力Pmtより公知の方法で吸気量を算出し、これに基づいてエンジン冷却水温等を考慮しつつ所望の空燃比を実現する燃料噴射量を算出決定する。

【0017】かくして、本実施例によれば、コンピュータの負担を増大せしめることなく、簡易な演算により吸気弁6閉弁時の吸気管圧力を推定して、これに基づいて最適な燃料噴射量を得ることができる。また、最終的な推定吸気管圧力は一次進み補償されているから、圧力センサ系に設けるノイズ吸収フィルタによる信号遅れの影響を小さくして、吸気弁6閉弁時の実際の吸気管圧力に近いものを得ることができる。

【0018】

【実施例2】上記実施例ではタイマ割込み毎に吸気管圧力Pmの差ΔPmを算出していたが（図2のステップ102）、算出間隔が短か過ぎて上記差ΔPmが十分な大きさにならないことがある。そこで、図3に示す本実施例はその解決を図ったものである。

【0019】図において、4ms毎に起動されるステップ201で吸気管圧力Pm、エンジン回転数Neを取り込んだ後、燃料噴射量算出時か確認し（ステップ202）、算出時でなければステップ214へ進んでカウンタcountをカウントアップし、処理を終了する。

【0020】燃料噴射量算出時であれば、検出された吸気管圧力PmをPmfとして記憶し（ステップ203）、下式⑥より圧力差ΔPmfを算出し、これを、吸気管圧力Pmfの変化量とする。

$$\Delta Pmf = Pmf - Pmfo \cdots\cdots ⑥$$

ここで、Pmfoは先回の吸気管圧力である。

【0021】続くステップ205で圧力Pmfを圧力Pmfoとして記憶し、続いて下式⑦により一次進み補償を行う。

$$Pmt = k \cdot \Delta Pmf + Pmfo \cdots\cdots ⑦$$

ここで、kは上記実施例1で説明したのと同様の定数である（⑤式参照）。

【0022】ステップ207では下式⑧より圧力差ΔPmtを算出し、これを、直線近似した吸気管圧力Pmtの変化の傾きとする。

$$\Delta Pmt = Pmt - Pmto \cdots\cdots ⑧$$

【0023】ステップ208で圧力PmtをPmtoとして記憶し、続いて吸気弁6閉弁（吸気行程終了）までの予め知られたクランク角と現在のエンジン回転数Neより、燃料噴射量算出時（現在）から吸気弁6閉弁までの時間t1 を算出する（ステップ209）。ステップ210で、ここまでのカウンタcountの値に4（ms）を掛けて先回の燃料噴射量算出時からの経過時間toを算出し、カウンタcountをリセットしておく（ステップ211）。そして、ステップ212にて、吸気弁6閉弁時の吸気管圧力Pmsを下式⑨で算出推定する。

$$Pms = Pmt + (t1 / to) \cdot \Delta Pmt \cdots\cdots ⑨$$

【００２４】ステップ２１３では推定した吸気管圧力に基づいて吸気量を算出して、所望の空燃比を実現する燃料噴射量を算出決定する。

【００２５】本実施例によっても上記実施例と同様の効果があるとともに、吸気管圧力の差を、間隔の離れた燃料噴射量算出時毎に行うから、圧力変化が相対的に小さい場合にも十分な差を得ることができる。

【００２６】なお、本実施例では、吸気管圧力の検出値を最初に一次進み補償して、その後、これら補償後の吸気管圧力より吸気弁６閉弁時の燃料噴射量を決定するようにしたが、上記実施例１をこれと同様にしても良い。

【００２７】

【発明の効果】以上の如く、本発明の燃料噴射制御方法によれば、車両加速時等の過渡状態における実際の吸気量を簡単な演算で正確に推定することができるとともに、圧力センサ系に設けるノイズ除去フィルタによる信号遅れに起因した吸気量推定誤差も除去することが可能である。

【図面の簡単な説明】

【図１】本発明を実施するハードウエア構成を示す系統図である。

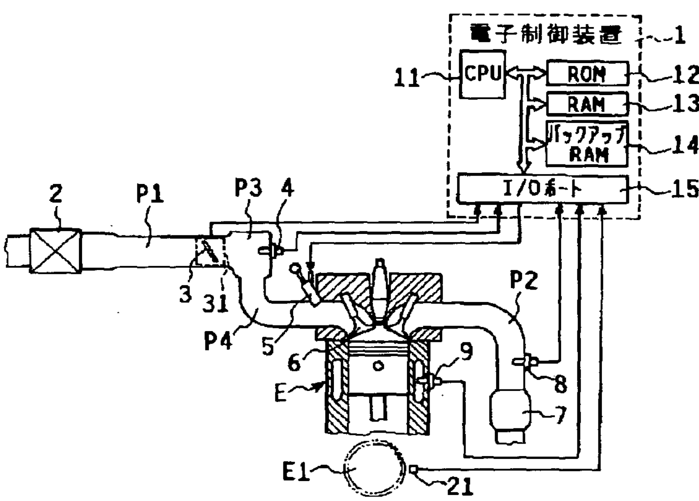
【図２】本発明の実施例１を示すプログラムフローチャートである。

【図３】本発明の実施例２を示すプログラムフローチャートである。

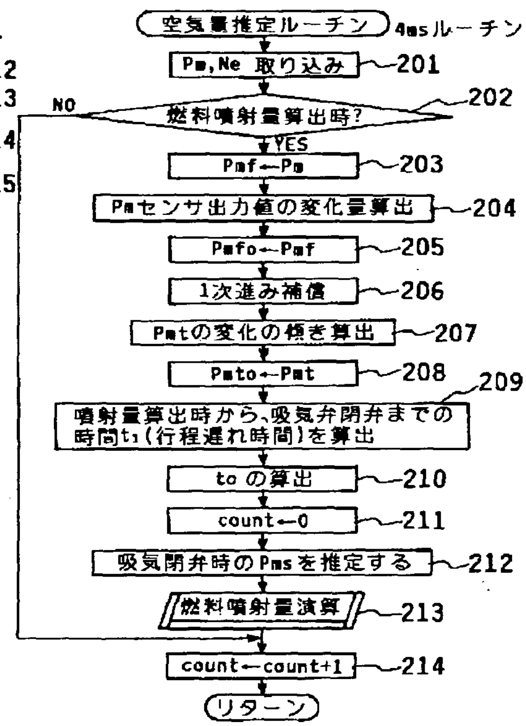
【符号の説明】

１　電子制御装置（ＥＣＵ）
１１　ＣＰＵ
１２　ＲＯＭ
１５　Ｉ／Ｏポート
４　圧力センサ
６　吸気弁
Ｅ　エンジン
Ｐ１　吸気管
Ｐ３　サージタンク

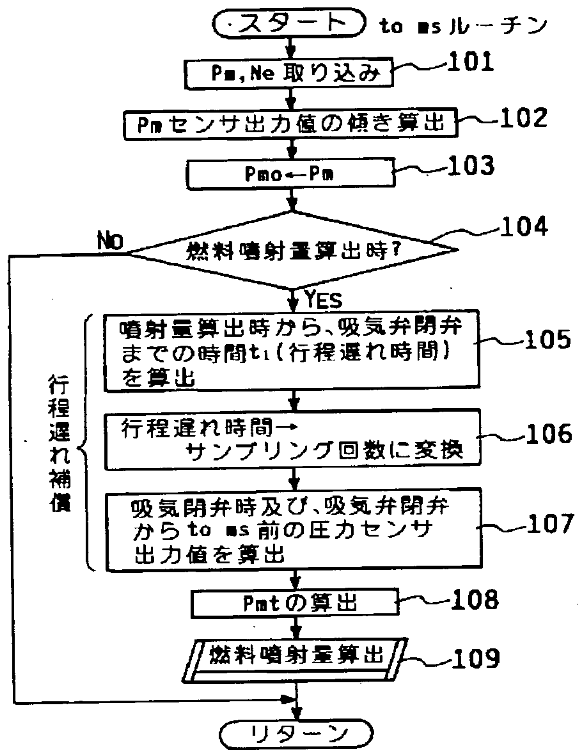
【図１】



【図３】



【図2】



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